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## The Relation of Frustration and Motivation to the Production of Abnormal Fixations in the Rat

*By*

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# THE RELATION OF FRUSTRATION AND MOTIVATION TO THE PRODUCTION OF ABNORMAL FIXATIONS IN THE RAT

## INTRODUCTION

### THE NATURE OF THE ABNORMAL FIXATION

THE TRADITIONAL usage of the term fixation has been to describe habits or associations that are well established. The degree of fixation was usually measured by the amount retained after some interval of arbitrary duration. The term fixation has also been employed in abnormal psychology without any basic change in the quantitative implications of this concept. For example, Sears (46) uses fixation to denote habits that are overlearned or very strong. In this case a habit is considered as fixated if it takes longer to unlearn than an ordinary habit. However, few investigators have tried to distinguish fixations from habits on a qualitative basis. Maier, Glaser and Klee (24) have attempted such a distinction. These investigators demonstrated that fixations could be established which were qualitatively different from strong habits in the sense that they could not be changed by the customary methods of trial and error learning. Maier and his associates termed this type of behavior an *abnormal fixation* in order to distinguish it from the other kinds of responses which have been called fixations.

The abnormal fixations were obtained in the following manner. One group of rats was subjected to a problem that was insolvable in the sense that any consistent response the animal might make could never be successful more than 50 percent of the time. As the Lashley jumping apparatus (15) was used, whenever the animal jumped against a locked

door it would bump its nose and fall into a net below. When the door was unlocked, the animal would knock the door over and gain admittance to a food platform which lay behind. As a control, another group of animals was allowed to develop a position habit of their own choosing, the choice being determined by the first jump. The animals were motivated by food and were given an air blast to force a response if they showed a tendency to hesitate. The control animals quickly formed position responses which they maintained with very little variation. The animals subjected to the insolvable problem also developed position responses after some trials. Both groups were then allowed to practice their position responses for 160 trials. Under these conditions the animals in the control group were rewarded 100 percent of the time, whereas the rats in the experimental group were successful on half the trials and failed on the other half. To test the nature of the habits formed under these two different conditions, both groups were then given 200 trials in which to solve a simple discrimination problem. A door with a black circle on a white background was made the positive stimulus whereas a door with a white circle on a black background was made the negative stimulus.

The majority of the control animals learned this discrimination after an average of about 50 trials, whereas the majority of the animals subjected to the insolvable problem not only failed to make the discrimination but failed to abandon the position response. These

animals without deviation continued to respond in terms of the position response. The performance of the two groups of animals fell therefore into two separate distributions. As the amount of reward that the animals in the control group received was twice that of the experimental group, it might be expected that the controls should have the stronger habits. Since this was not the case, the authors concluded that the animals which had failed to abandon their position habits had formed a different kind of response. These were called abnormal fixations to differentiate them from habits.

Furthermore, it was found that although the presence of the fixation prevented the rat from performing the now correct discrimination response, this failure to perform correctly was not due to an inability to learn the discrimination. This was shown by the different reactions to the positive and negative stimulus made by the fixated rat. When the negative card was on the side to which the position fixation would compel him to jump, the rat would hesitate for some time and considerable amounts of air pressure would be necessary to force a response. When the animal finally did jump, he would jump so as to hit the negative door with the side of his body instead of head-on as is usually the case. In other experiments (24, 26) it was shown that, if the animal is prevented from making the incorrect response that the fixation would compel him to make and if the rat is forced instead to make the correct one, the discrimination is performed thereafter both immediately and correctly.

Animals in the first experiment that had fixated their position habits were then given an additional 100 trials in which the negative card was always on

the side to which the position fixation compelled them to jump. No animal abandoned his fixation under this condition, despite the fact that the fixated response was now punished 100 percent of the time. A second experiment by Maier and Klee (25) showed that seven out of ten of the above animals still retained their position fixations after a period of four months vacation from the situation. Furthermore, although these animals were retested in the discrimination problem for a period lasting several months none of the seven abandoned its position fixation. Injections of metrazol and the resultant convulsions did NOT have any effect on these fixations. Metrazol served merely to increase the frequency of the "neurotic seizures" which occurred at various times.<sup>1</sup>

<sup>1</sup> I wish to take this opportunity to correct misstatements of fact made by Griffiths (8) in connection with the effect of metrazol on fixations and convulsive tendencies in the rat allegedly found by Maier and Klee (25). He states: "Recently Maier has published a report dealing with the permanence of behavior tendencies in 'fixated' and 'non-fixated' animals. In this report the author referred to metrazol as having a therapeutic effect on abnormal behavior. Maier gave metrazol to animals, obviously for the purpose of determining whether it had any therapeutic value for attacks in psychological tests. He found that metrazol reduced the relative frequency of attacks to the negative card situation. This investigator stated that it was the metrazol, rather than its convulsion, which was the active agent in preventing the seizures." (8, p. 2) The reference Griffiths has used here is incorrect as there was no mention of fixation in that study (27). The correct reference should be Maier and Klee (25). Furthermore, we found absolutely no effect of metrazol on the abnormal fixation.

In regard to the neurotic seizures Griffiths quotes supposedly from Maier, Glaser and Sacks (27): "'... metrazol has a therapeutic value, presumably lowering the excitation value of the negative card situation'" (8, p. 26). On pages 27 to 28 Griffiths again misstates the facts: "If the drug does act as we have determined it is unlikely that it has therapeutic properties regarding the seizures as Maier has claimed in another portion of his research" (8, p. 27-28).

The facts are, and I quote from the study of Maier and Klee that has to do with this problem, as follows: "The ratio between the number

The authors concluded on the basis of these results that the fixation was permanent in nature. Since the fixation was not influenced by the ordinary conditions of trial and error learning the authors further decided that the fixation is qualitatively different from the learned response and that it is abnormal in nature. The term *abnormal fixation* was employed, therefore, to designate those responses to a situation which can be shown to be relatively uninfluenced by such changes in the situation which require a modification of the animal's behavior.

In a third experiment by the same authors (26) it was demonstrated that responses other than position habits can be fixated. In one part of the experiment, animals which had learned first a position habit and then a discrimination response were subjected to an insolvable problem. Most of these rats continued to respond to this new situation in terms of the discrimination response. Many were unable to relearn the position re-

sponse when the situation was again made solvable, this time in terms of the original position habit. Instead, these animals continued to make the jump which was correct only for the discrimination problem. Thus it was shown that discrimination responses can also be fixated. Some animals even fixated manners of jumping.

The characteristics of the abnormal fixation may be summarized as follows: (1) It is permanent in nature and must be distinguished from the temporary reduction of variability produced by ordinary learning methods which characterizes the strong habit; (2) it is not due to an inability to "learn" a new habit; but to the animal's inability to perform the new response required by the situation; and (3) it is not confined to a specific kind of response since almost any response may become fixated.

With these characteristics of the abnormal fixation in mind, let us now turn to a further analysis of the conditions necessary to produce it.

of seizures to the positive and negative cards for the metrazol period is 11:36, and for the control period (the period before metrazol was used) 1:26. The metrazol period thus tends to increase the number of attacks to each of the cards by the same absolute amount (ten attacks) and thus reduces the relatively greater effectiveness of the negative card" (25, p. 387). "The number of attacks in the positive and negative card situations are five and ten, respectively (ratio 1:2), for the injection days, and six and twenty-six (ratio 1:4.3) for the non-injection days. This is consistent with the previously noted finding that metrazol reduces the relative frequency of attacks to the negative card" (25, p. 387). "Metrazol also resulted in a 74 percent increase in the frequency of attacks and reduced the difference between the relative effectiveness of the positive and negative card situations" (25, from the summary on p. 389).

Griffiths' conclusion that, "From these statements it is evident that the true action of the drug is hopelessly confused" (8, p. 26) seems to be based on the fact that he did not distinguish between a "relative" reduction of attacks to the negative card caused by an "absolute" increase in the number of attacks to both cards, and an "absolute" reduction.

#### THE DEGREE OF INVOLVEMENT AS A FACTOR IN FIXATIONS

The literature concerned with the production of fixations and the allied problem of regression has been adequately summarized by Sanders (45), Everall (5), Mowrer (34), Kleemeier (13), and especially Sears (46), and hence will not be reviewed here in detail. These and other authors have considered several factors in their causal relation to the production of fixations. Among the causes have been listed the factors of brain injury, excess repetition, characteristics of the situation (type of apparatus and procedure), strength of drive, emotional shock, and frustration. Sears (46) lists many others such as generalization, sub-goal reinforcement, etc., that

have to do chiefly with the strength of the habit formed. However, if the term fixation is to have any meaning other than that of a strong habit, most of these factors probably would not apply. Although the purpose of the present paper is to demonstrate frustration as the necessary condition for the production of the abnormal fixation, the other factors cannot be ignored since they may contribute to the efficacy of the frustration.

The restrictive character of the situation has been recognized as facilitating the production of "experimental neuroses" (28). The relative lack of success in the production of the experimental neurosis in the rat and the human is due in large measure to the fact that the experimenter has not been successful in confining the animal to a limited situation. The neurotic seizures described by Maier (19) have also been found to increase when the animal was confined to a greater degree by the situation (8, 21, 23, 25). This was done by restricting the number of choices available to the animal. The possibility of abortive jumping in conflict situations was reduced, the rat was placed in smaller enclosures, the walls were made opaque, etc. All these constraints were designed to involve the animal in the situation to the greatest degree possible. By these means the rat was made to react more to the conflict and less to the extraneous factors which could have provided means of escape. Witkins has expressed this relation nicely: "... the more restricted the animal's field of action, the greater the difficulty which a conflict situation will occasion" (52, p. 64-65).

For non-conflict situations it has been generally recognized that some procedures cause the animal to learn or at least eliminate errors more quickly than others. The conditioned response meth-

od is probably the best method yet devised as far as its ability to reduce irrelevant behavior is concerned. In this method, the animal's response to the situation can be selected by the experimenter from the very beginning of the experiment. However, other techniques have been employed which more or less successfully restrict the animal to a narrow situation. Lashley (15), for example, found that with an apparatus that required the animal to jump to the stimulus chosen he could force the animal to make difficult discriminations more quickly than with the discrimination box. Diamond (3) found one trial habit formation in a non-selective situation with the jumping apparatus. Shocking the rat for any choice in a situation where all choices were of equal value likewise caused the animal to limit himself to one mode of responding. Muenzinger and his collaborators in their monumental series of studies developed these findings still further. They found that shocking responses after the choice point regardless of whether or not the response was right or wrong (35, 40), making the animal jump a gap following a choice point (39), enforcing delay at the choice point (37), or making the animal escape from shock (36) were superior to rewarding the animal with food for a successful response as far as the speed of learning was concerned. However, when animals were shocked before the choice-point many developed persistent position habits which delayed the learning of the discrimination. Jackson (12) has reported that situations which require the animal to jump rather than run to the goal cause the animal to become highly repetitive in its behavior. Gilhousen (7) found with a multiple path jumping maze (the paths were made up of small platforms from which the rat had to

jump to the next, etc.) that animals which were forced to take a long route through the maze were reluctant to abandon it when a shorter path was made available. This persistence was probably a function of the frequent gaps the animal had to cross. As Gilhousen has suggested this technique presented to the animal a "strong problem solving situation." What would have happened if the animals which quickly learned the discrimination response in the experiments of Muenzinger *et al* had been required to abandon this response for a different one is not known. The repetitive nature of behavior in jumping and shock situations suggests that the acquisition of the new habit would have been considerably delayed.

Shock grids to be crossed and gaps to be jumped restrict the animal's field of activity as shown by the reduction in the amount of irrelevant behavior in those situations. At the same time, these factors serve to motivate the animal to a higher degree to perform the solution of the problem as is demonstrated by the more rapid learning found under these conditions. However, once the response has been established the animal is reluctant to abandon it.

The strength of the hunger drive has been shown to cause the animal to confine its response to the relevant characteristics of the situation. Elliott (4) showed with a multiple equal choice apparatus that a strong hunger drive caused a greater stereotypy of behavior than a weak hunger drive. Thus restriction of the behavioral field can be produced by internal as well as external stimulation.

The frequency with which a habit has been practiced has been considered by some authors to influence the variability of the response. Krechevsky and Honzik (14) reported that an excess repetition

of a habit seemed to reduce its docility as tested by a required change in the response. The results of Gilhousen's experiment (7) (see above) would at first glance tend to contradict this. He found that animals which had been forced to jump along one route fifteen times were just as likely to abandon this route for a shorter one as rats which had practiced three different routes a total of fifteen times (five times each route). Both groups were less able to abandon these longer routes for a shorter path than a group which was forced six times over one path. Kleemeier's (13) results are similar to Gilhousen's. He found that animals which had adopted habits similar to previously practiced habits as the result of an electric shock had no more difficulty in changing to a new habit than animals which had adopted relatively unpracticed habits. The results of these three experiments indicate that the length of time the animal has spent in the situation is more important than the frequency with which one response has been practiced as a factor in reducing variability in behavior. The longer the animal has been in the situation the less likely it is to alter its habits. In its effects, additional practice acts to further confine the animal to a more limited situation.

The various devices employed in the studies described here can be considered to have been based on a variety of psychological principles. These devices have been designed to increase the animal's attention, or to increase the animal's drive, or to increase the animal's caution, or to restrict the animal's scope of activity, or to facilitate the learning process somehow. When the selective conditions of the situation favored one response over another, that response was learned more rapidly. When no one re-

sponse was rewarded or punished more than any other response, the animal did not vary his behavior. Instead, it quickly settled down to one mode of responding. The main point is that whatever the selective conditions of the situation might have been, the animal did react as a whole to a greater degree than when these added restrictive and motivational factors were not present. In other words, the animal may be said to have been involved in the situation to a greater degree.

As Maslow (31) has recently indicated, frequently more than just the frustrating situation is necessary in order to account for the abnormal reactions produced. Often, when the animal is faced with a barrier or deprivation he may cease to react to it and do something else in a different direction. Maslow suggests that there must also exist in such a situation a "threat" to the personality of the organism. However, as Maslow admits himself, "threat" must be defined in terms of the organism's experience. As we can only know the nature of its experience in terms of the reactions produced by it, such a definition becomes circular. Of course, this difficulty may be overcome by stating that in the case where the animal does not seem to react abnormally to the situation, the frustration was not sufficient in amount and scope to produce such reactions. On the other hand, abnormal reactions to frustration do occur where the specifically frustrating conditions are seemingly relatively minor. A concept that includes the restrictive and motivational characteristics of the situation and which would enable us to predict when a particular frustrating situation is likely to produce abnormal reactions, would be of great use.

I would like to suggest tentatively for

this purpose, the concept of *the degree of involvement of the organism in the total situation*. This concept may be defined in terms of the objective characteristics of the known behavioral field. These will include setting up of barriers in space or time, and/or manipulation of the animal's motivation. Either or both of these should force the animal to respond to a greater degree to the situation as a whole. Irrelevant behavior or escape mechanisms would thus be reduced to a minimum.

In and of itself, the *degree of involvement* is not to be thought of as a cause of abnormal behavior. Rather, it must be considered as a condition essential in most situations for the production of such reactions only in so far as it would enable frustration to occur. From this, it would be expected that, the greater the degree of involvement, the greater the effect the frustrating situation is likely to have on the animal as measured by the abnormal reactions to the situation. Also, the frustrating situation need not be as severe where the involvement is greater.

#### EMOTIONAL TENSION VERSUS FRUSTRATION AS THE CAUSATIVE AGENT IN THE PRODUCTION OF THE ABNORMAL FIXATION

Most of the work that is applicable to the problem of the role of emotion in the production of fixations was done with the express purpose of studying regression. In the usual regression experiment some form of T apparatus was employed. The animal had first to learn to go to the one side, usually the preferred one and after this habit was established the animal was taught to go to the other side. After the animal had learned the second habit it was given an electric shock at the choice-point. If the animal

then reverted to the first habit it was considered to have regressed.

However, many of the experimenters discovered that regardless of what habit the animal adopted as the result of a shock the animal tended to fixate that response. Hamilton and Krechevsky (11) were among the first to suggest that the question of regression was gratuitous to the main problem of the fixation of the habit. These fixations were "precipitated" by shocking the animal at the choice-point either before the animal had learned one or more habits or afterwards. Regardless of whether the animal continued the response in progress, "regressed" to a previously performed habit, or adopted a new one, the resulting response was usually stereotyped in nature. These authors measured the resulting fixations by the deviation from that habit on the shock trials. No test was made, however, of the animals' ability to abandon this stereotyped response for a new one.

Maier, Glaser, and Klee (24) suggested that regression as interpreted in many of the comparative studies was an artifact of the experimental procedure. In the usual regression experiment the apparatus offered the animal the choice between two responses. If one of these was made the first response and the other the second response, the fact that the animal adopted the former might mean that the rat had regressed to it, or that having experienced an interference in the performance of the second, the animal adopted a new habit which of course would resemble the first. O'Kelly offered a somewhat similar explanation. He suggested that the shock might be associated with the second habit and that the reversion to the first habit might be just "an escape from shock" (41, p. 50).

In order to overcome these objections

Kleemeier (13) employed a multiple choice apparatus that gave the animal the choice of four alleys in addition to the starting alley. Animals were taught to go to one alley and later to another. They were then shocked at the choice-point. If electric shock produced regression alone one might expect all of the animals to return to the habit that had been established first. This was found not to be the case. The majority of the animals continued to respond in terms of the habit in progress, whereas of the remaining rats only a few more than chance would allow regressed, while the rest began to respond to a new alley (digressed). A new habit was then made available to the group which had perseverated but many still refused to abandon this second response. Even when the shock was admitted, or the fixated habit alone was shocked, or the response was completely blocked at the choice-point, many of the animals just refused to run rather than try a new habit. In a second experiment the same procedure was repeated except that the animals which had regressed and those that had digressed, as well as those perseverating were required to learn a new habit. About the same proportion in each category failed to abandon the habit which had been established during the 50 shock trials. A control group which had learned two habits but which had not been shocked, receiving instead 50 trials additional practice in the second habit, very quickly adopted the new habit when the selective conditions of the experiment were changed. Thus as the result of electrical shock abnormal fixations were produced.

Whether an animal will persevere, regress, or digress seems to depend upon the same factors that determine the degree of involvement. Martin (30) and

Kleemeier (13) found that the relative frequencies with which the different responses had been practiced might determine the "choice of neurosis" that developed as the result of the shock. The animal usually chose the more frequently practiced response. However, the previous practice did not seem to influence the abnormal fixation since it was shown that habits developed as the result of digression were just as likely to be fixated as the habits formed by perseverating and regressing animals.

O'Kelly (42) had animals form habits under conditions of two different strengths of motivation in a T apparatus. After two habits were learned, one under a strong hunger drive, the other under a weak hunger drive, the animal was shocked at the choice-point. He found that the animals tended to persist in the habit formed under the conditions of the stronger motivation regardless of which habit was learned first. Thus the relative strength of the drive can determine which habit will be adopted in the shock situation.

Another important factor that will determine which response is to be fixated is the place in the apparatus where the shock is administered. Kleemeier (13) reported that unless the shock was administered along the entire length of the starting alley and not just at the choice-point, the animal simply refused to run. However, when the animal was shocked from the very beginning of the starting alley it was forced again to run. Thus the factors which determine the degree of involvement also determine the situation in which the animal will be involved and the kind of abnormal behavior that will result.

Other experimenters have reported abnormal fixations to result from the shock situation. O'Kelly found: "When ani-

mals are given an electric shock after being trained in a situation offering only one mode of response they will fixate on that mode of response for a relatively long time after the response has become seemingly inappropriate" (42, p. 68).<sup>2</sup> Some of these animals were abnormally fixated since they were on subsequent tests unable to perform a new and different response. Martin (30) also found fixations to result from shock. Probably Diamond (3), Muenzinger and Wood (40), Everall (5), Mowrer (34), and Sanders (45) would have found that many of the animals that had been subjected to electric shock had fixated if they had tested the nature of the habits formed under these conditions. These investigators were, however, primarily interested in other questions.

As electrical shock was employed in all the studies except those of Maier and his associates (24, 25, 26) the emotional effects of the shock were usually considered to be the factor underlying the production of the fixation. Kleemeier concluded from his experiments: "It is believed that in both the frustrating situation (Kleemeier is referring to the experiments of Maier, Glaser and Klee, 24) and in our shock situation, there comes into being an emotional element that is specifically associated with the particular situation. It is this emotional element as a product of the strong motivation or the frustrating situation that may account for the development of the abnormal fixation" (13, p. 33). Everall concluded that "... perseveration . . . is the result of emotional excitement" (5, p. 366).

However, no experimenter has yet shown that the production of emotions in the animal outside the situation, either in time or space, has much effect

<sup>2</sup> Italicized in the original.

on the animal's behavior in the situation. Steckle and O'Kelly (48, 49) found no effect from shocking an animal outside the situation on the regressive or perseveration tendencies in a regression set-up when compared to a control group (not thus previously shocked). Sanders (45) shocked her animals outside the situation immediately before each trial and obtained no evidence of regression in the situation even though her animals usually regressed when the same shock was administered inside the situation. Even when adrenaline in large doses was injected into the animal before the daily runs no effect was observed. McCullouch and Bruner (17) provide the only exception to this generalization and their results are capable of another interpretation entirely. The animals which had been shocked in a different situation had learned to take the shock, and when later it was used to motivate an avoidance reaction, the first response to the shock that had been learned interfered with the new one.

Other experiments, such as that by Sanders (45) who rang an electric bell at the choice-point, and that by Muenzinger and Newcomb (38) who sounded an electric buzzer for right and wrong responses, showed these types of stimuli to be relatively ineffective when compared with electrical shock either for producing regressive behavior or for restricting the animal's irrelevant behavior. Buzzers and bells are by no means to be overlooked as far as their emotion-arousing qualities are concerned. (This can be seen from the vast literature on "neurotic seizures.") On the other hand, they offer little directed impedance to the animal's behavior as compared with shock.

Thus there is no reason to believe that emotional excitement *qua* emotional excitement causes any of the behavior dis-

turbances that concern us here. Only if the emotion producing stimulus is specifically related to some aspect of the situation can we expect abnormal manifestations in the behavior of the organism. In the latter case, in so far as the emotional stimulation arouses an intense motivation, e.g., to escape shock, we can expect the animal to become involved in the situation to a greater degree and hence a reduction of variability in its behavior. But the animal will behave abnormally only if the emotional situation provides sufficient frustration (i.e., causes the animal's responses to this situation to fail).

The strength of the motivation has been found to be positively related to the strength of the abnormal reactions produced by frustration. In the experiments of Sears and Sears (47) and Marquis (29) the satisfaction of the hunger drive in neonates and young infants was interrupted by withholding the bottle at various times during the feeding period. The earlier the bottle was withdrawn, the hungrier the infant would be, and the greater the reaction that was obtained. The same relationship has been shown in experiments recently reported by Masserman (32, 33). He first trained cats to open a box for food. Later he subjected the cat to an air blast which would hit it in the face every time it opened the food box. Opening the food box, remained, however, the animal's only means of obtaining food. Various abnormal reactions appeared as the result of this frustrating situation. These abnormal reactions could be increased or decreased by increasing or decreasing the cat's hunger drive.

Maier, Glaser and Klee have indicated the way in which they conceive of frustration: "We prefer to limit the term frustration to designate the state where

continued failure causes learning functions to cease operating and other mechanisms of adjustment to begin operating" (24, p. 540). From the above analysis the use of the word "continued" is probably not necessary. Conceivably the frustration could occur in one trial providing that some "catastrophic" shock were used that could both frustrate the animal and at the same time acutely involve him in the situation. This would be the case in the regression experiments. There the electric shock, suddenly introduced at the choice point, frustrated the animal by suddenly making an easily handled situation into one to which there could be no adequate solution. The shock at the same time markedly increased the motivation to solve it. As the result of the shock the animal fixated one of the many possible modes of behavior. On the other hand, in the experiments of Maier and his associates (24, 25, 26) perhaps the frustration was cumulative and "continued" would best describe the operations necessary to produce the abnormal behavior. Here the animal was subjected to an insolvable problems over a period of time.

That the length of the frustration period need not be an extended one was demonstrated by Maier and Klee (26). In one part of this experiment two groups of animals which had developed position habits of their own choosing were used. One group was then required to learn a discrimination habit. The other group was required to reverse its position habit. Following the introduction of the change

in the situation there would be of course a period before the animal changed its old habit for the new one. This period for the first group would produce 50 percent punishment of the old habit. For the second group there would be 100 percent punishment of the old habit. The greater percentage of punishment for the second group produced fixations in this group, while no fixations were found in the first group. However, those animals in the second group which did reverse their habits did so very quickly (after 8.6 trials on the average). This suggests that the fixated animals in the group must have been frustrated within this brief period before they had a chance to perform the new habit.

Frustration, then, may either be built up gradually for the animal as a whole until it passes the level of tolerance, or it may be all or nothing for various parts of the animal's behavior repertoire. The answer to this question will have to depend upon further experimental analysis. It may be that the temporal aspect of the problem merely increases the degree of involvement rather than the frustration itself. Whatever the case may be, the following relationships may be expected to hold. The less the animal is involved in a particular situation, the greater the amount and scope of the frustration one would need to create to produce an abnormal fixation; and the greater the degree of involvement of the animal in the situation, the less the frustration would have to be.

## STATEMENT OF THE PROBLEM

ALTHOUGH the above analysis indicated that the causative factor underlying the abnormal fixation was the frustration produced by the animal's inability to handle a particular situation, no direct experimental analysis of this question has been made. The present experiment is designed to investigate this problem. For this purpose two groups of rats under different conditions of motivation will be subjected to an insolvable problem. If emotional tension is the cause of the fixation, a group of rats subjected to air blasts in this situation would be expected to fixate, and a group of animals motivated by food alone would not be expected to do so. On the other hand, if frustration is the causative factor, one would expect to find abnormal fixations to result from an insolvable problem under either condition of motivation. The motivating conditions would instead contribute to the degree of involvement of the animal in the situation.

Furthermore, if the emotional effect of the air-blast were sufficient to cause an abnormal fixation, a control group subjected to the air blast, but given free unpunished choice in the situation, would be expected to fixate. This would not be true for the group motivated by food under these free conditions. If frustration is considered as the causative factor, animals in both motivational groups would be expected to react ab-

normally only in so far as the situation itself might be frustrating.

If the latter is the case, then the different forms of motivation might play an important part in determining the structure of the situation to which the animal will react. Just how the animals will react to the hunger and the air blast cannot be determined on an *a priori* basis. It might be expected that the air blast would serve as an added restriction in the animal's behavioral field. However, the preliminary training would have to be sufficient to keep the animal subjected to air blasts from merely trying to escape the emotion-arousing stimulus. Thus the animal would be involved in the situation to a greater degree. In the case of the animals motivated by food, no such external restriction would be present. The degree to which the animal was then involved in the situation would be determined by the strength of the association of food with the responses that would attain it. These possibilities will have to wait for empirical verification.

The problem is also designed to obtain additional evidence in confirmation of some of the findings by Maier and Klee (26) in an earlier experiment. These relate to the type of response that can be fixated, the effect of guidance in breaking the fixation, and other questions about the abnormal fixation raised here and in other studies.

## PROCEDURE

### APPARATUS

A MODIFIED Lashley jumping apparatus was used in this experiment (15). This method requires that the animal jump a gap ( $8\frac{1}{2}$  inches in this case) at one of a pair of cardboard doors placed in two windows (six inches by six inches) in a wall. The doors in either or both of the two windows may be locked or unlocked or the window may be completely open. If the window the rat has chosen is not locked, the card will be knocked down by the force of the jump and the rat will land on a platform behind the wall where he can be given food. If the door in the window is locked, the rat will bump against it and fall three feet into a net below. The windows are far enough apart and they are separated by a "nose piece" (projecting  $1\frac{1}{2}$  inches towards the stand from which the rat is to jump) so that the animal is prevented from making a response to both windows at once. The platform from which the rat is required to jump is 9 by 5 inches. It has an air jet at the rear projecting  $\frac{1}{4}$  inch above the surface of the platform which points in the direction of the windows. The visual patterns of the two doors were arbitrarily chosen as a black circle, 8 cm. in diameter, on a white background for the one card, and a white circle of the same size on a black background for the other.

### PRELIMINARY TRAINING

The preliminary training used in this experiment is similar to that employed in the study by Maier, Glaser, and Klee (24). The rat was first taught to jump through the open window, and following this, was taught to knock down the cardboard doors. Guidance was used to prevent the formation of specific habits

during this period. The guidance method employed here consisted of holding the rat back from making a response not desired by the experimenter or covering a window with the hand so as to remove it as a stimulus. This initial training period lasted four days. After this all of the rats were given additional practice in jumping at the cards for a four day period. The doors were switched from side to side in a random order and the jumps were guided to both sides and to both cards with equal frequency. The animal thus jumped 20 times to each door and side for a total of 40 trials at the rate of 10 trials per day. This additional practice was designed so as to permit the animal to adjust to as many extraneous factors in the situation as was possible. It also helped to equalize the effect of the early training for all animals.

### EXPERIMENTAL GROUPS

In order to test the relative effectiveness of frustration as a factor in the production of fixations, the rats were divided into two main groups. In one group the animal was driven by an air blast to make a response, but received no food for successful jumps. The other group was given food for a successful jump but the rat was not forced to jump if it failed to respond. In Table 1, these groups are represented as air-motivated (Group I) and food-motivated (Group II), respectively.

Those animals which were driven to respond by air were given the air in four stages. For the first 30 seconds no air was applied at all. If the rat failed to respond during this period, a mild degree of air was given for 30 seconds. This was followed by air pressure of

moderate strength for another 30 seconds. Then, if the rat still refused to jump, the air was applied at full pressure for an additional period of 90 seconds. (The maximum pressure amounted to from 10 to 14 pounds tapped from the University air compressor.) If, at the end of this period, the rat still refused to jump, it was prodded with a light steel rod until it chose one of the windows.

air motivated animals so that both groups would start to work on any one day under the conditions of 24 hour food deprivation. If hunger is considered to be an emotional stimulus, both groups would be equal in this respect. Thus if the objection is raised that the food-motivated animals were under the emotional pressure of hunger, the answer would be that the animals motivated by the air blasts would be just as hungry

TABLE I  
The structure of the experiment

Main Groups	Air-motivated		Food-motivated	
	Insolvable Problem Situation (Group IA)	No-problem Situation (Group IB)	Insolvable Problem Situation (Group IIA)	No-problem Situation (Group IIB)
Part A				
Part B	All groups given a problem to solve the solution of which required a change of habit. All animals are guided which failed to solve the problem. All animals given additional practice in the second habit.			
Part C	All groups subjected to the insolvable problem situation.			
Part D	All groups given a problem to solve the solution of which required a change of habit.			

Although food had been used to facilitate the initial training of these animals, no food was given on the apparatus once the experimental techniques had begun. These rats were fed their entire rations in a separate feeding cage immediately after their day's run. Thus, although the air-motivated animals were under the conditions of 24 hour food deprivation, food was never a reward for any one specific choice in the situation as was the food for the second group. As the former did not receive their food until after the tenth trial, the only reward for the air-motivated rats would be the escape from the air blast and the successful admittance through the window to the platform behind. Any pattern of ten jumps would suffice for the day as far as the food was concerned.

This procedure was adopted for the

and would be given the air in addition. Furthermore, the air-motivated animals were never given the opportunity to even partially satisfy their hunger and hence diminish the emotional conditions during the ten trials.

Those animals which were motivated by food were likewise given ten trials per day. They were allowed to take a bite of food for every jump that knocked down a card and enabled them to go through the window. At the end of the ten trials the food-motivated animals were allowed to finish their day's rations on the rear feeding platform.<sup>3</sup> Thus these animals were usually able to finish a good part of their daily rations by the tenth trial.

<sup>3</sup> The food-motivated animals were placed on the rear feeding platform after the tenth trial even though the tenth jump or for that matter any or all of the jumps might have been unsuccessful.

It was soon apparent from the responses of the food-motivated animals that a time limit for each trial had to be established if other rats were to be run each day. This limit was arbitrarily set at four hours per trial. If the rat failed to jump on any one trial within the prescribed period, it was returned to the home cage unfed. The next day this procedure would then be repeated.

#### PART A. THE INSOLVABLE PROBLEM AND THE NO-PROBLEM SITUATIONS

In the first part of the experiment the air-motivated and the food-motivated groups were each subdivided into two approximately equal sub-groups. Groups IA and IIA, half of the air-motivated and half of the food-motivated groups respectively, were given an insolvable problem. Groups IB and IIB, the other halves respectively, were given no problem at all. These subdivisions may be seen in Table 1.

The insolvable problem situation was so designed that one of the cards on one of the sides would be locked on any one trial. The position of the locked card and the kind of card that was locked was changed in a random fashion. Therefore any consistent response the animal might make would be successful only 50 percent of the time. The rest of the time the animal would bump against the locked card and fall into the net below.

In the no-problem situation, no card or side was locked at any time. Any jump at either of the two windows would be successful under these conditions. This situation was designed so that frustration would be at a minimum. Any difference between the two differently motivated groups should then be clearly revealed.

As has been mentioned above, animals

in a situation that requires a jump very quickly adopt one type of response, such as a choice of the right side. The animal will repeat this response with very little variation. In the present experiment the animals were continued in their respective situations until they had made 157 responses of one type out of 160 trials. Any jump to one of the windows or cards, whether or not it was successful, was considered as one trial. The response ultimately formed under the conditions of this part of the experiment will hereafter be referred to as *habit A*. Immediately after meeting the criterion for the formation of *habit A*, the rat was subjected to the procedure in Part B.

#### PART B. THE TEST FOR FIXATIONS AND THE FORMATION OF A NEW HABIT

Part B. was designed to determine whether or not there was a difference in the kind of habit formed by the various groups during Part A. More particularly, in which group were fixations most likely to occur? To test this the rats in all groups were given a new problem, the successful solution of which required the adoption of a response different from *habit A*. Therefore, if the animal had a position response, it was given a discrimination problem to solve. If the rat had as *habit A* a discrimination response, it was given a position habit to learn.

Previous studies (24, 26) have shown that most animals are able to perform a new habit under these conditions within 50 to 150 trials. The 200 trials allowed for this change, therefore, was considered to be ample. Animals that learned within this period were continued in the new *habit B* until a criterion of 157 correct trials out of 160 had been met.

Animals which failed to abandon *habit A* within 200 trials were trained to make the B response by guidance. The guidance procedure consisted of restraining the animal from making the incorrect response and of pushing it in the direction of the correct window. This was done by hand. Guidance was continued until the animal showed signs of responding freely to the correct, but hitherto avoided window or card. These rats were then continued under the conditions of the correct *habit B* until they had made 157 correct (but not guided) jumps in 160 trials.

At the end of Part B all rats with or without help, had acquired a response which enabled them to be successful all of the time. All animals upon finishing Part B went immediately into Part C.

#### PART C. THE INSOLVABLE PROBLEM SITUATION

In Part C, all rats were subjected to an insolvable problem. As above, any consistent mode of behavior was successful 50 percent of the time and punished 50 percent of the time in a random order. Again, the criterion was 157 responses of the same type out of 160 trials. The animal under this new condition of frustration might persist in *habit B*, shift to an old habit, or adopt a new one. For convenience the response meeting the criterion in this part will be designated as *habit C*.

#### PART D. THE TEST FOR FIXATIONS

As soon as the animals had met the criterion in Part C, the situation was again made solvable. If the rat had a

discrimination response to one of the cards as *habit C*, the situation was made solvable in terms of a position habit not previously practiced. If the rat had a position response as *habit C*, a discrimination response was made the positive habit. In this way any differences in behavior caused by the conditions of frustration in the foregoing part could be detected. Again the animals were given 200 trials in which to acquire the "adaptive" *habit D*. The criterion of learning used in this part of the experiment was 30 consecutive errorless trials (10 trials per day).

The schedule of the experiment and the group divisions are given in Table 1 for convenient reference.

#### ANIMALS EMPLOYED

In the present experiment 51 albino and black-hooded rats were used. These were animals from the laboratory stock and were four to five months of age at the beginning of the experiment. There were 12 rats in each of Groups IA, IB, IIB, and 15 animals in Group IIA. Litter mates were divided equally among the four sub-groups whenever possible. The 24 males and 27 females were about equally divided among the four sub-groups. Six of each sex were put in a group; the three extra females were placed in Group IIA.

Because of the extreme slowness of some of the food-motivated rats, it was impossible to run all the rats at one time. The animals were run, therefore, in four sets, it taking three to five months to complete the experiment for any one set of rats.

## RESULTS

## PART A. THE FORMATION OF RESPONSES UNDER THE CONDITIONS OF THE INSOLVABLE AND THE NO-PROBLEM SITUATIONS

*Types of Response Formed*

As has been previously found (24, 26), most naive animals tend to adopt position responses when subjected to an insolvable problem. They consistently maintain this position response in the face of the 50 percent success and punishment that any response under these conditions would entail. Table 2 shows the

discrimination responses favored the card having a white circle on a black background. As there were no selective factors in the situation itself, such responses as were obtained must be considered to have been based on the rats' natural preferences.

*Number of Trials Before the Formation of Habit A*

Many of the rats in all four sub-groups varied their responses to some degree before meeting the criterion of 157 re-

TABLE 2  
Types of response formed during Part A

Group Sub-group	Air-motivated		Food-motivated	
	IA Insolvable Problem	IB No-problem Situation	IIA Insolvable Problem	IIB No-problem Situation
No. rats in each sub-group	12	12	15	12
No. rats adopting position habits	11	12	10	10
No. rats adopting discrimination habits	1	0	2	1
No. rats refusing to respond	0	0	8	3
No. rats starving to death	0	0	1 (5)*	1
Mean No. trials before <i>habit A</i> is formed	57.5	15.0	68.3	41.7
Range	0-370	0-180	0-390	0-200

\* Three of these five were retrained and two had to be dropped from the experiment. Most of these five would have starved to death if allowed to do so.

distribution of the types of responses formed by the members of the various sub-groups as to the kinds of jumping habits formed in Part A. All groups show about the same small proportion of discrimination habits to position habits: IA-1:11; IB-0:12; IIA-2:10; IIB-1:10. Three rats in Group IIA and the one rat in Group IIB are not included in these figures. These four rats were lost through starvation. The position habits for all groups were about equally divided between the right and left sides. For those forming position habits, 23 went to the window on the left side and 20 consistently went to the window on the right. All of the animals adopting

sponses of the same type in 160 trials. The average number of trials exclusive of the criterion trials may be seen in Table 2. All types of responses are combined here. As can be seen from the ranges obtained, the individuals differed greatly in this respect.

Three comparisons can be made with these data. First, it is possible that the air-motivated animals would try to escape the air blast instead of responding to the relevant aspects of the situation. Because of this the air-motivated animals might be expected to take fewer trials than the food-motivated rats before adopting *habit A*. This was checked by using the t-test of the significance

of a difference between means of independent small samples (16). Only animals which ultimately formed position habits were considered here in order to keep these small samples as homogeneous as possible. Table 3 shows that no significant difference was obtained when Groups IA and IIA, Groups IB and IIB, or all air-motivated and all food-motivated animals are compared. Thus the two differently motivated groups must

in the insolvable problem situation adopted *habit A* just as quickly as the animals in the no-problem situation.

Third, the various groups may be compared on the basis of the number of rats which vary their behavior before adopting a consistent habit under the conditions of Part A. An inspection of the two differently motivated groups showed that no difference would be found. Therefore critical ratios were

TABLE 3

Significance of the difference between the mean number of trials exclusive of the 160 criterion trials needed to form a position habit in Part A

Groups to be compared	Mean No. of trials to form position habits in Part A		Difference between means	t Value	df	% Level of significance
	M <sub>1</sub>	M <sub>2</sub>				
When IA is M <sub>1</sub> and IIA is M <sub>2</sub>	60.9	68.3	7.4	.150	19	80-90%
When IB is M <sub>1</sub> and IIB is M <sub>2</sub>	15.0	34.0	19.0	.578	20	50-60%
When IA and IB are M <sub>1</sub> And IIA and IIB are M <sub>2</sub>	37.0	51.2	14.2	.523	41	60%
When IA is M <sub>1</sub> and IB is M <sub>2</sub>	60.9	15.0	45.9	1.353	21	10-20%
When IIA is M <sub>1</sub> and IIB is M <sub>2</sub>	63.3	34.0	29.3	.496	18	60-70%
When IA and IIA are M <sub>1</sub> And IB and IIB are M <sub>2</sub>	64.4	23.6	40.8	1.543	41	10-20%

be considered alike in the speed with which they formed *habit A*.

Second, the animals subjected to the insolvable problem might have varied their behavior over a longer period of time than the rats in the no-problem situation before adopting a consistent mode of responding. As can be seen in the lower half of Table 3, no significant differences were obtained between Groups IA and IB, IIA and IIB, or all animals in both Groups IA and IIA and both Groups IB and IIB. Thus animals

calculated only for the differences in the percentages of rats varying their behavior (6) in the A groups and those in the B groups, both for Groups IA and IB, Groups IIA and IIB, and all of the A groups *versus* all of the B groups. Table 4 shows that 10 or 91% of the 11 rats in Group IA varied their behavior before adopting *habit A* whereas only 1 out of 12 or 8% of the rats in Group IB did so. The difference of 83% gives a CR of 7.13. As such a difference can be expected more than 99.9%

of the time the difference may be considered as significant. The CR of the difference between Groups IIA and IIB is 1.975. This difference may be expected 98% of the time. The CR of the difference between the percentages of the animals in the A groups and the B groups is 5.33. This has the significant expectancy of occurring 99.9 times in 100. Thus significantly more animals will vary their behavior in an insolvable problem situation than in a no-problem situation.

The last two comparisons can be taken

ing to try to solve the problem. In the no-problem situation the necessity to vary stemmed directly from the rat. Witkin (51) has recently reported the same thing to hold true for running type situations.

#### *Refusals to Respond in the Food-Motivated Groups*

A few irregularities in the procedure occurred for some of the animals in the group motivated by food and subjected to the insolvable problem. These had best be taken as individual cases.

TABLE 4

Significance of the differences in percentages between the groups of those rats which varied their responses before meeting the criterion of their A habit  
(Position habits only)

Groups to be compared	No. Rats	No. which vary their responses	% varying	$D_p$	$\delta D_p$	CR	Chances in 100 that difference is real
IA	11	10	91	83	.1163	7.13	99.9
IB	12	1	8				
IIA	10	7	70	40	.2025	1.98	98.0
IIB	10	3	30				
IA plus IIA	21	17	81	63	.1183	5.33	99.9
IB plus IIB	22	4	18				

to mean only one thing. In non-selective situations<sup>4</sup> some of the rats will vary their responses for a certain length of time, the degree to which they will do so depending upon the individual and not on the situation. The situation will only determine whether or not the rat will vary his behavior at all. More rats did so in the insolvable situation because there the animals were required to change their behavior if they were go-

<sup>4</sup> The insolvable problem and the no-problem situations are non-selective in that the former rewards or punishes the animal 50 percent of the time for any response and the latter rewards the rat 100 percent of the time for any response.

One animal after 10 trials settled down to a position habit which was maintained for 80 trials. During the last 19 of these, the rat developed so severe an abortive jump<sup>5</sup> that it failed to gain admittance through the unlocked window. On the next four days this animal refused to jump within the allotted four hour period. The rat was then returned

<sup>5</sup> A jump which causes the rat to hit the foreward wall or window of the jumping apparatus with the side of the body instead of the nose and forelegs. If the card is unlocked, the rat often gains admittance rear-end first as the animal is pivoted around the edge of the window by the force of the jump. This type of jump was first analyzed by Maier (19).

to the open window period of the preliminary training and through retraining was again brought up to the beginning of the experimental period. After this there was little or no resistance to jumping during Part A.

A second animal refused to continue after the first eleven trials and was allowed to starve for four days before retraining (as above) was instituted. After being returned to the experimental situation the rat made only 16 jumps in five days. It was again retrained, after which it ran 39 times in four days and then refused entirely to jump on the next three days. Once again the rat was retrained, this time for a period of twelve days. After this the animal succeeded in finishing Part A without going hungry for more than the usual 24 hour period.

A third rat refused to continue after the third trial in Part A. It was retrained after four days' starvation and thereafter the rat completed this part of the experiment without undue hesitation.

One other rat was retrained. This animal was a member of Group IA. It was the only instance of an air-motivated animal failing to respond to the relevant aspects of the situation and reacting to the air alone. After 21 trials this rat began to jump straight up into the air when forced to respond by the air blast. Somewhat later the rat consistently leaped off the jumping platform to the side of the apparatus instead of towards the windows. One retraining period was sufficient to correct this condition.

As retraining consisted of guidance to a large extent, and as Maier and Klee (26) found that guidance reduces the susceptibility to frustration, this retraining procedure was hereafter abandoned for animals which refused to jump lest

the number of fixations be reduced. Animals run later in the experiment which refused to respond were allowed to starve either until they did respond or died of starvation. (It might be noted here that the animals which had been retrained during this part of the experiment never fixated *habit A*.)

Another two animals in Group IIA which refused for several days to jump had to be abandoned. It was found to be impossible to run them and the others too in the short 24 hour day. These rats were not again resumed. One animal, also in Group IIA, did starve to death after completing only seven trials. This animal would spend the four hour period every day sitting on the jumping platform. Its posture seemed to be completely lacking in tone. As with other cases of starvation obtained later, it was found dead in its cage two weeks after the onset of the refusal to jump.<sup>6</sup>

Two other animals in this group showed great resistance to jumping during this period. One after four trials refused to finish that day and start the next but thereafter jumped very well. The other animal stopped after 29 trials for one day, resumed jumping for 123 trials, stopped again for two days, and thereafter finished Part A.

Thus eight animals of the 15 rats originally in Group IIA refused to continue to respond at one time or another. One starved to death, two after a period of starvation continued to jump, two had to be abandoned for lack of time, and three were retrained, one being retrained

<sup>6</sup>Several of the animals which later starved to death, after four to six days of refusal tried to fall off the jumping platform directly into the net below. Some would do this as many as 200 times in the four hour period. These animals would be picked up and replaced immediately upon the jumping stand. The animal would abandon this type of behavior after a few days and thereafter just sit or crouch on the platform during the entire four hour period.

three times. Of the last five rats several would probably have starved to death if they had been continued under the routine experimental conditions.

In Group IIB the animals were never punished for a jump to any one of the windows or cards. They were rewarded with food 100 percent of the time. Refusal to jump would obviously be quite a rare occurrence as there was no sort of frustration present. Only three of the twelve animals in this group showed any evidence of refusal to respond within the allotted four hour period. Two of these cases refused to jump for one day only. One of these refusals followed an accidental fall off the jumping platform. The other is inexplicable. Both resumed jumping the following day. The third case may be considered to be an instance of self-frustration. This rat after 60 trials of 100 percent reward for a position habit began to jump abortively. After three such responses it abandoned the one side for the other and ran perfectly for the next 80 trials. The rat again began to jump abortively and to such a great extent that it began to miss the window altogether. After two such exaggerated jumps it ceased to jump at all and gradually starved to death.

All cases of refusal to jump with the exception of the one case in Group IIB followed a series of one or more failures to reach the food platform. Most of these refusals occurred early in Part A.

With the exception of the food-motivated animals which refused to respond, there would appear to be no fundamental difference between the reaction of the air and the food-motivated animals. This is true at least as far as the types of responses and the number of trials to form these responses are concerned. The cases of refusal to respond,

however, do indicate that the food-motivated animals were in a somewhat differently structured situation than were the air-motivated rats.

In the next part we shall see if the techniques used in Part A have produced any other differences in the behavior of the members of the various sub-groups that are not otherwise apparent.

#### PART B. THE TEST FOR FIXATIONS FORMED UNDER THE CONDITIONS OF PART A

##### *Type Responses Formed as the Result of a Change in the Habit Required*

At the end of Part A, each animal had a response which it had made at least 97 percent of the time in the last 160 trials. In order to test for fixations of *habit A*, the situation was changed so that the animal was required to abandon this response for a new one. If the animal had developed a position habit, a discrimination response to the black circle on white was made the successful habit; and if the rat had developed a discrimination response to one of the cards, a change to a position habit was required. The animal was given 200 trials in which to make this change.

The results of this change in the situation can be seen in Table 5. Of the 12 animals in Group IA (air-motivated), 9 continued to respond on the basis of *habit A* and hence may be considered to have fixated. Three learned the new response. Of the 12 rats in Group IB, only 2 fixated and 10 abandoned *habit A*. Of these 10, 9 successfully learned *habit B*, and one changed from its first position habit to a position response to the opposite side.

Of the food-motivated animals, 2 of the 12 in Group IIA fixated their posi-

tion habits, one starved to death, and 9 successfully learned the new response. In Group IIB, none of the 11 animals fixated, two starved to death and 9 successfully learned *habit B*.

Two major comparisons can be made with these data. First, the number of fixations produced in the insolvable problem situation can be compared with the number produced in the no-problem situation. This comparison should give an indication of the relative effectiveness of the presumably frustrating in-

mals had formed position habits in Part A and were unable to abandon them for the discrimination response as required in Part B. Instead the rats continued through the 200 trial period in these position habits. Of the 23 rats in Groups IB and IIB, 2, or 8.7% persisted in *habit A*. The difference of 37.1% between the percentages fixating in each major classification gives a CR of 3.16. This difference has the significant expectation of more than 99.9 times in 100. These data may be seen in Table

TABLE 5  
Types of response found in Part B as the result of a change in the selective pattern of reward and punishment

Group Sub-group	Air-motivated		Food-motivated	
	IA	IB	IIA	IIB
No. rats in each sub-group	12	12	12	11
No. rats fixating	9	2	2	0
No. rats refusing to respond	0	0	1	6
No. rats starving to death	0	0	1	2
No. rats changing	3	10*	9	9
Mean No. trials to abandon <i>habit A</i>	53.0	42.3	85.9	25.1
Range	16-69	5-93	3-167	11-40
Mean No. trials before adopting <i>habit B</i>	5.0	9.0	1.6	3.2
Range	0-14	0-28	0-5	0-9

\* One of these animals abandoned *habit A*, but failed to learn *habit B*, a discrimination response. The rat adopted a different position habit instead.

solvable problem. Secondly, the number of fixations produced under the conditions of air-motivation can be compared with the fixations obtained when the animal is motivated by food. Thus we will be able to form an opinion as to the necessity of some emotional stimulus in the production of fixations.

#### *Fixation as the Result of the Insolvable and the No-problem Situations*

Of the 24 animals which remained in Groups IA and IIA, 11, or 45.8% were found to have fixated. All of these ani-

6. Thus a significantly greater number of fixations resulted under the conditions of the frustrating insolvable problem.

This difference is also found to be maintained when the sub-groups are compared with each other within the main divisions. For this purpose, only the animals with positive habits as *habit A* will be considered. In no case was a discrimination habit fixated.

The number of animals having position responses at the beginning of Part B and the number of rats fixating these

responses in each of the sub-groups are shown in Table 6. Of the 11 rats with position habits in Group IA, and of the 12 rats in Group IB, 9 and 2 animals fixated, respectively. They consistently maintained their position responses throughout the 200 trials. The CR of the difference in percentages fixating

pulsion to remain in the one type of response to the situation. The reward and punishment values of the selective type of situation have, therefore, no longer the comparable effect on the frustrated rat as they do on rats not previously exposed to the conditions involving frustration.

TABLE 6  
Significance of the difference in percentages between the groups of those rats fixating in each group\*

Groups to be compared	No. Rats	No. Rats fixating	% Rats fixating	$D_p$	$\delta D_p$	CR	Chances in 100 that difference is real
IA	11	9	82.0	64.5	.1595	4.04	99.9
IB	12	2	17.5				
IIA	10	2	20.0	20.0	.1265	1.58	94.0
IIB	10	0	00.0				
IA plus IIA	24	11	45.8	37.1	.1174	3.16	99.9
IB plus IIB	23	2	8.7				
IA	11	9	82.0	62.0	.1715	3.62	99.9
IIA	10	2	20.0				
IB	12	2	17.5	17.5	.1096	1.59	94.0
IIB	10	0	00.0				
IA plus IB	24	11	45.8	37.1	.1174	3.16	99.9
IIA plus IIB	23	2	8.7				

\* When the individual groups are compared only animals which have adopted position habits as their A habit are included in this table. When the larger groups are compared, all animals are included. Rats which started Part B but starved to death in this part are included in all comparisons.

between these two groups may be seen as 4.04. This difference may be expected to be obtained more than 99.9 times in 100, and is therefore significant.

The difference between the percentages of Groups IIA and IIB (20% and 00% respectively) although having an expectation value of only 94 times in 100, again shows the greater number of fixations produced as the result of the frustrating insoluble problem. Frustration leads to the fixation of the response so that the animal is under the com-

#### *Fixations Produced Under the Two Conditions of Motivation*

In Table 6 it can be seen that 11 of the 24 air-motivated animals or 45.8% fixated whereas only 2 of the 23 remaining food-motivated animals of 8.7% fixated. All fixations were of the position responses formed as *habit A*. The difference between the percentages fixating in each group is 37.1%. This difference is found to have a CR of 3.16 and might be expected more than 99.9 times in 100. Thus a significantly greater num-

ber of the air-motivated animals were found to have fixated.

As can be seen in Table 6, when the sub-groups are compared, the difference between the percentages of position fixations in the two groups subjected to the insolvable problem (Groups IA and IIA) is 62.0%. This difference has the significant expectation of occurring 99.9 times in 100. The difference between the percentages which fixate *habit A* in Groups IB and IIB, has an expectancy of 94 times out of 100. This difference, although not quite significant, is in the same direction as the other differences obtained.

That blasts of air as a motivating agent play an important part in the production of fixations must be accepted because significantly more of the air-motivated animals fixated. However, the fact that two of the food-motivated animals which had been subjected to the insolvable problem fixated, indicates that no extreme emotion-arousing stimulus is necessary to produce these fixations. The frustration involved in the insolvable problem situation is the necessary factor in the production of fixations. Results in later sections further support this interpretation.

Two animals of the air-motivated group which had not been subjected to the insolvable problem were found to have fixated. These fixations can be explained by supposing that the newly introduced discrimination problem in Part B entailed sufficient frustration to fixate the old response before the animal could perform the solution to the new problem.<sup>7</sup>

#### *Starvation in the Food-Motivated Groups*

That the introduction of a new prob-

lem can produce frustration is demonstrated in a dramatic fashion when the two animals in Group IIB which starved to death are considered. These animals never made another jump after the 10th and 13th trial respectively following the introduction of the discrimination problem that was to be solved in Part B. Other animals in this group refused to continue for various lengths of time exceeding the four hour limit. Three of these four animals went 8, 3, and 6 trials in 3, 3, and 5 days respectively and never finished their food on any one of these days. The solution occurred shortly afterwards on the 4th, 5th, and 8th day respectively of period B. The fourth rat ran 10 trials and then refused to jump on the two days following this. The rat then went 20 trials on the next two days but did not finish the 6th and

animals could have been frustrated because they did not discover the solution to the discrimination problem soon enough. If they had, they would not have fixated. This hypothesis could be tested in another experiment by giving animals, which had formed position habits under the conditions of 100 percent success, discrimination problems of varying difficulty. More of the animals in the more difficult discrimination situation would be expected to fixate. Second, the animals could have been frustrated by the introduction of the new problem itself. Their position habits would fail because the rats would be punished 50 percent of the time. In this case the possibility that the rat might have discovered the solution earlier would be irrelevant. These two interpretations are not mutually exclusive.

However, if we accept the distinction that is generally made between learning and performance, it would be impossible to determine what would have happened if the animal had learned soon enough unless it performed the results of this learning. Many studies have shown that animals may learn a response and not perform it unless motivated to do so. The case of the fixated rat is analogous in that such an animal may also learn the new response and not perform it. As was shown in the Introduction, frustration and learning are conceived as two independent processes. Frustration produces fixations which prevent the performance but not the learning of the new habit. Therefore, it would be better to say that the animal fixated the old response before it could perform the new one, than that it fixated before it could learn the new habit.

<sup>7</sup> There are two possibilities here. First, these

7th day, running only 8 times in this period. The solution occurred for this rat shortly thereafter on the eighth day. Unlike the first two rats which completely refused to continue, these last four apparently were not as frustrated by the introduction of the new problem. They were able to go on and solve the problem a day or two later. Thus a total of six rats reacted strongly to the introduction of the new problem in Part B.

The food-motivated animals which had been subjected to the insolvable problem in Part A would, of course, not experience any increase in the amount of punishment when a new problem was introduced. As these animals were already being punished half the time the introduction of the discrimination problem would only change the pattern of reward and punishment and not the amount. The animal would be successful when it jumped at one kind of card and completely unsuccessfully when it jumped at the other card. As a result it would not be expected that many of these animals would refuse to jump when Part B was started. Only one animal in this group refused to respond at any time. It developed a refusal to respond on the 13th day of Part B. This refusal was associated almost exclusively with the negative card when it was presented on the side to which the rat's position habit caused him to respond. The rat began to refuse to jump at about the same time that the other animals in this group were changing from *habit A* to the new response. The animal finally starved to death because it refused to jump at the negative card. Apparently it was unable to jump to the positive card on the side opposite to his fixation. This rat may be considered to have been additionally frustrated by the negative card which it was learning to

avoid at that time, but to which its position fixation compelled it to jump.

In general, the evidence on refusal to respond seems to show that the rat reacts to the frustration at an early stage if it is going to react to it at all. The members of Group IIA refused to respond early in the insolvable situation. Group IIB rats refused to respond very soon after the introduction of the new discrimination problem and the frustration associated with it.

#### *Formation of the New Habit by Animals not Fixating*

The average number of trials to abandon *habit A* that were taken by the animals which did not fixate are shown in Table 5. The last line in Table 5 shows the average number of trials intervening between the time the rats gave up *habit A* and the time *habit B* was adopted. The three animals in Group IA which solved the problem required an average of 53.0 trials (range, 16-69) before *habit A* was dropped. The nine animals in Group IB abandoned their first response after an average of 42.3 trials (range, 5-93). The nine non-fixated rats in Group IIA needed an average of 85.9 trials (range, 3-167) to change from *habit A*. The nine animals in Group IIB required an average of 25.1 trials (range, 11-40) to give up their first response. The average number of trials after *habit A* was abandoned and preceding the adoption of *habit B* for Groups IA, IB, IIA, and IIB, were 5.0, 9.0, 1.6, and 3.2, respectively.

Discrimination habits formed in Part A were abandoned very quickly for the position habit in Part B. Of the four rats which had discrimination habits, three dropped them after an average of only 14.7 trials (range, 3-25). They needed an average of 6.3 additional trials

before the position habit was satisfactorily performed. The fourth rat starved to death early in Part B. Considerably more trials were required by animals with position habits before they were abandoned for discrimination responses. An average of 79.3 trials were necessary before the position habit was dropped and an average of 7.2 further trials were taken before the new discrimination response was performed within the limits of the criterion.

Because animals changed more rapidly from discrimination to position habits than from position to discrimination responses, and because there were only

ence and the hypothesis that there is no difference as to the speed of learning under the two motivating conditions must be accepted.

When (Table 7) the two food-motivated groups are compared, the seven animals subjected to the insolvable situation in Part A (Group IIA) were found to have abandoned their position habits after an average of 92.1 trials. The nine rats in Group IIB took only an average of 25.1 trials to do so. The difference of 67.0 trials between the averages of these groups gives a *t*-value of 4.44 which is significant well below the one percent level. The reason that

TABLE 7

Significance of the difference between the mean number of trials before position habits formed in Part A are abandoned for discrimination responses learned in Part B

Groups to be compared	No. Rats	Mean No. trials before <i>habit A</i> is abandoned in Part B	$D_M$	df	<i>t</i>	Percent level of significance
IB	10	42.3	17.2	17	1.54	10-20%
IIB	9	25.1				
IIA	7	92.1	67.0	14	4.41	0-1%
IIB	9	25.1				

three cases of solution in Group IA, detailed comparisons will be made only between those animals in the three remaining groups which were required to shift from a position response to a discrimination response.

It can be seen in Table 7 that there was a difference of 17.2 trials between the average of 42.3 trials for the 9 rats in Group IB which abandoned their position responses and an average of 25.1 trials for the nine animals in Group IIB. The *t*-value of this difference is only 1.54. This is significant only between the 10 and 20 percent level. Thus no confidence can be placed in this differ-

animals which are to go from an insolvable problem to a solvable one change more slowly than animals which are suddenly interrupted in the successful performance of an habit by a new problem, has already been discussed by Maier, Glaser, and Klee (24). Suffice it to say, the animal which has adopted an habit under the conditions of 50 percent random punishment would be expected to take longer before it noticed that the pattern of punishment had been made selective in nature than would a rat which had been successful 100 percent of the time before the new problem was introduced. The obvious implication is

that the change in the amount of punishment is important from the perceptual aspect. The greater the change in the amount of punishment, the more the change in the habit would be facilitated. However, as Maier and Klee have shown (26), the greater amount of punishment might frustrate the animal before it can perform the solution of the problem and hence cause a fixation of the response in progress.

There were no significant differences between the various sub-groups in the average number of trials it took after *habit A* was abandoned and before *habit B* was started within the limits of the

animal in IB which had changed from one position habit to another instead of to the correct discrimination. The new position response was equally as non-adaptive as his original position habit. This rat was therefore taught the discrimination habit by guidance. The second rat, a member of Group IIB, actually did learn the discrimination. However, it developed an exaggerated abortive jump to the positive card whenever this card was on the side which the animal had formerly avoided. This type of jump caused it to miss the window completely on all jumps to that side. This rat was given 200 trials in which

TABLE 8

Significance of the difference between the mean number of trials after the first habit is abandoned and before the next habit has begun to be within the limits of the criterion

Group to be compared	No. Rats	Mean No. trials after <i>habit A</i> is abandoned and before <i>habit B</i> is begun	$D_M$	df	t	Per cent level of significance
IB	10	9.0	5.8	17	2.04	5-10%
IIB	9	3.2				
IIA	7	1.3	1.9	14	1.33	20%
IIB	9	3.2				

criterion. These data may be seen in Table 8.

#### *The Effect of Guidance on Fixations*

At the end of Part B, all but two of the animals which had not fixated were graduated to Part C immediately upon making 157 correct responses out of 160 trials in terms of the habit learned in Part B. The fixated animals and the two exceptions mentioned above were taught the habit to be learned in this section by the technique of guidance, since they had failed to alter their behavior in the allotted 200 trials.

Of the two exceptions, one was the

to abandon the abortive jump, but as it failed to correct his jump, guidance was instituted. However, 200 trials of guidance were of no avail and the animal had to be dropped from the experiment. One other animal which solved the problem in Part B also fixated an abortive jump. This rat jumped abortively to the card it had avoided in Part A. (The rat had a discrimination response in Part A.) Since the abortive jump did not interfere with the success of the jump, no attempt was made to guide the animal out of this abnormal response. These are but two of the many instances of fixations of abortive jumps encountered

in the studies of fixation that have been made so far.

The procedure of guidance has already been described above. However, as the fixated response would cause the animal to be correct on half the trials, the guidance procedure would only be necessary for those trials on which the fixation would compel the animal to make a wrong choice.

The thirteen animals in the various sub-groups that had position fixations required guidance from 2 to 24 times on 1 to 5 days. These rats began to meet the criterion satisfactorily after an additional 0 to 4 days. The results obtained from the guidance technique substantiate a point made by Maier, Glaser, and Klee (24), that the fixation is of the performance only. It does not prevent the learning of the new problem, even though this learning can be expressed only within the area of the fixation itself. Ten of the thirteen rats had to be guided on an average of 3.6 trials (range, 2-7) over an average period of 1.2 days (range, 1-2). Only one of the ten animals required an additional day before it began to meet the criterion. This is far less than the average number of trials needed under the usual conditions of selective learning as found in the present experiment. The food-motivated animals in Group IIB changed from *habit A* to *habit B* after an average of 28.3 trials, whereas the air-motivated animals in Group IB took an average of 51.3 trials to make this change.<sup>8</sup>

<sup>8</sup>The data for the non-fixated animals given in Table 5 separates the learning period into two parts: the average number of trials before *habit A* was abandoned, and the average number of trials before *habit B* was adopted. As this distinction is not relevant to the comparison given in the text immediately above, the averages for the two periods have been combined. These totals then represent the average number of trials taken by the non-fixated animals to learn the new response in Part B.

The unusually rapid "learning" by the guided animals is due to the previous exposure to the problem and not to any particular virtue of the guidance procedure as a facilitating process. This can be demonstrated by comparing the ten rats mentioned above with the three rats which took considerably longer to shift. The latter three animals needed 16.3 trials of guidance on the average (a range of 10 to 24 trials), and an average of two days (range, 1-4) before they began to perform adequately the problem that was to have been learned in this part. These three animals differed from the other ten fixated rats in that the former had developed exaggerated abortive jumps. This type of jump caused them to completely miss the window to which the fixation compelled them to jump. They thus had very little opportunity to experience the problem during the 200 trials it was presented to them. Two of the three were animals in Group IB which started jumping abortively soon after the introduction of the problem in Part B. The third animal was a member of Group IA which jumped abortively in Part A. Thus, if the guidance were an important facilitating agent which caused the rapid shift in habit of the first ten rats, it should have been equally effective for the last three. Since it was not, the effect of the experience of the problem within the limits of the fixation, must be considered to be the factor underlying the rapid learning of the ten. This is true even though the solution of the problem had never been performed *per se* by these animals. The guidance was necessary, however, to break up the fixation so that the fixated animal could perform what it had already learned.

After completing 157 correct responses in 160 trials, these formerly fixated ani-

mals were immediately advanced into Part C on an apparently equal footing with the non-fixated rats.

PART C. RESPONSES FORMED DURING THE SECOND INSOLVABLE PERIOD

*The Effect of a Period of Frustration on Rats with Well Established Habits*

At the end of Part B, 43 rats remained, all of which had habits that had been practiced on at least 157 out of 160 trials. These habits had been obtained either through learning or, as in

production of the fixation was believed to have been the frustration of these animals. In Part C, all rats were subjected to the insolvable problem in order to determine the effect of this frustrating situation on animals which had a well established habit.

It can be seen in Table 9 that 34 of the 43 animals (79.1%) continued in *habit B*. Thus, the majority of the rats persisted in the second habit despite the fact that this response was punished 50 percent of the time. All these animals

TABLE 9  
Responses formed in Part C

Group	Type of response at end of Part B	No. rats continuing <i>habit B</i>	No. rats refusing to respond	No. rats starving to death	Rats forming a response other than <i>habit B</i>		
					Total	Rats adopting responses similar to previous ones	Rats adopting new responses
IA	11 discrimination habits	8	0	0	3	1 adopted a position habit as in Part A	2 adopted new position habits
	1 position habit	0	0	0	1		1 adopted a new position habit
IB	12 discrimination habits	10	0	0	2	1 adopted a position habit as in Part B	1 adopted a new position habit
IIA	9 discrimination habits	9	0	0	0	1 adopted a discrimination habit as in Part A	1 adopted a new position habit
	2 position habits	0	1	0	2		
IIB	8 discrimination habits	7	2	1	0		
Total	43	34	3	1	8	3	5

the case of the fixated animals, established with the aid of guidance. Table 9 (left hand columns) shows the type of responses that the animals in the various groups had when they started Part C. In all, 40 rats had discrimination responses to one of the cards and three rats had position habits to one of the sides.

It will be remembered that in Part A the insolvable problem caused most of the rats to develop position habits which in some cases were later found to have been fixated. The causative factor in the

persisted in a discrimination response. These habits were exceedingly stable since 99.66% of the responses were of the same type and only .34% (19 responses in 5510 trials) were deviations. Further evidence of the stability of these responses is indicated by the fact that 14 of the 19 deviations were made by two of the animals.

Only one animal starved to death in this part of the experiment. This animal was a member of Group IIB.

The remaining eight animals adopted

a response that was different than *habit B*. These animals are described in the two right hand columns in Table 9. Five of the eight rats formed completely new habits in this part. Three of these five animals changed from discrimination habits to position responses and two switched from position responses on the one side to position habits on the other side. The other three rats abandoned *habit B* for the responses that were similar to habits that had been practiced in earlier sections of this experiment. One of these three rats adopted a response similar to the discrimination habit it had formed in Part A. The second animal formed a position habit like the one it had adopted in Part A and which was found to be fixated in Part B. The third rat changed to a position habit which was similar to one it had acquired in Part B. (This was the animal which failed to learn the discrimination response, but instead, reversed its position habit.) Of the 43 rats which reached this part of the experiment, only the last three can be considered to have regressed in the sense of historical regression. The other five animals that made a change, developed entirely new habits.

The results of this section further substantiate those obtained by Maier and Klee (26) and Kleemeier (13) who found that, when animals are suddenly frustrated in a given habit, the majority tend to persist in that habit. If the insolvable problem or the shock situation does not cause the animal to persist, it will merely serve as a new problem. In the latter case, the animal will abandon the habit in progress and adopt a different response. Should the new response resemble an earlier habit, it will be by accident.

The results disagree with those obtained by several authors (11, 30, 34, 42, 45) who considered that they had demon-

strated historical regression under somewhat analogous conditions. Even if we just consider the eight rats whose habits were disrupted, only 37.5% of these regressed. As there are four choices available to the animal (two types of position and two types of discrimination habits) the three cases that seemed to regress could be expected by chance alone.

However, the problem is not this simple. Of the eight animals that shifted their responses, five abandoned discrimination responses for position habits, two reversed their position habits, but only one rat changed from a position habit to a discrimination response. Maier and Klee (26) also found a predominance of shifts from discrimination to position habits under similar conditions. Thus when a change does occur as the result of frustrating conditions, the majority of the rats tend to adopt position habits. Maier and Klee (26) have suggested that the position habit may be considered to be a more primitive form of behavior. Primitive is not used here in the historical sense but rather in the sense that the response is simpler. As this response is so often preferred, it might be considered to be closer to the innate organization of the animal and hence to be more undifferentiated. Werner (50) has suggested "global" to characterize this type of behavior.

The analysis of regression made by Barker, Dembo, and Lewin (1) is more applicable to the results of the present experiment. According to these authors, the animal can be considered to have regressed if it forms a more global response under frustrating conditions. Whether or not this response had ever been made before would be irrelevant. The results obtained in Part C definitely support their interpretation of the problem.

The air-motivated animals showed no

greater variation in Part C than did the animals motivated by food. Six of the 24 rats in Groups IA and IB changed their responses (25.0%) as compared to two of the 19 animals in Groups IIA and IIB which did so (11.1%). The difference of 13.9% has a CR of 1.20. This difference can be expected only 88 times in 100 and is, therefore, not significant. There was no significant difference in the number of animals changing their responses between the groups subjected to the insolvable problem and the groups given the no-problem situation in Part A. Likewise, about as many of the animals which fixated *habit A* were found to form new responses as animals that had not previously fixated. Thus, the animals of the various sub-groups appear to have reacted in the same way to the insolvable problem to which they were subjected in this part of the experiment.

The eight animals which did adopt new habits took an average of 61.3 trials (range, 10-145) to abandon *habit B*. They required an additional 61.5 trials, on the average, (range, 0-137) before they satisfactorily formed the new response. These figures are within the ranges obtained in Part B for the change from *habit A* to *habit B* and constitute further evidence for the belief that these eight animals reacted to Part C as a new problem.

#### *Refusal to Respond as the Result of the Insolvable Problem*

One rat in Group IIB starved to death. It refused to respond to the situation after the sixth trial. Only one other animal of the seven remaining in this group refused to jump. This refusal was temporary in nature. The rat refused to jump for three successive days following the fifth trial of the first day. On the fourth day it started to respond again

and went on to finish the remaining 155 trials without further interruption. The other six members of this group, although some were extremely slow to jump, never refused to respond within the allotted four hours. One would expect that the rats in Group IIA would have been better adjusted to the situation than the rats in the other food-motivated group since the former animals had been subjected to the insolvable problem in an earlier period. This prediction is borne out by the fact that only one of the eleven animals in this group refused to respond. This was the animal that had been retrained three times in Part A. The day following the introduction of the insolvable problem, this rat shifted from a right position habit to a discrimination response that was similar to the one it had adopted in Part A. It then failed to finish the sixth, seventh, tenth, twelfth, and thirteenth day. On the seventh trial of the seventeenth day this rat adopted a left position habit and then refused to finish that day and the next. From then on, it ran 160 trials in the latter habit and gradually began to jump more quickly on each trial.

The small number of animals which refused to respond to the present frustrating situation suggests that the food-motivated animals are involved to a greater degree in the jumping situation. They no longer seem to balk at the situation as a whole as they had done in previous parts of the experiment. This is especially true of the animals in Group IIA. On the other hand, the rats in Group IIB had never been subjected to the insolvable problem. These could be expected to, and did, show a somewhat greater reaction to this situation. There was no apparent change in the behavior of the air-motivated animals in this sec-

tion of the experiment except an increase in their resistance to jumping.

PART D. THE TEST FOR FIXATIONS  
FORMED UNDER THE CONDITIONS  
OF PART C

*Types of Responses Formed After the  
Situation Is Made Solvable*

At the end of Part C, 42 rats remained that had practiced one habit 157 times in 160 trials under the conditions of 50 percent reward and punishment given at random. In Part D the pattern of

may be seen in Table 10. Five of the twelve rats in Group IA, four out of the twelve in Group IB, three of the eleven in Group IIA, and two of the seven rats in Group IIB fixated the habits they had in Part C. The rest of the animals successfully solved the problem presented to them. No rat starved to death in this part.

The conditions which formerly distinguished the procedures of the various groups in Part A no longer maintain. Of the 23 animals remaining that had

TABLE 10

Types of response found in Part D as the result of a change in the selective pattern of reward and punishment

Group Sub-group	Air-motivated		Food-motivated	
	IA	IB	IIA	IIB
No. rats in each group	12	12	11	7
No. rats fixating	5	4	3	2
No. rats refusing to respond	0	0	3	5
No. rats starving to death	0	0	0	0
No. rats changing	7	8	8*	5*
Mean No. trials to abandon <i>habit C</i>	49.0	34.5	63.6	98.0
Range	11-151	9-110	9-186	30-197
Mean No. trials before adopting <i>habit D</i>	22.4	10.5	22.6	6.0
Range	9-39	0-21	0-129	0-9

\* One animal in each of the two food-motivated groups reverted to and persisted in *habit C* after satisfying the criterion for *habit D*.

reward and punishment was changed so that only one type of response would be successful. Animals with position habits were given the opportunity to learn the discrimination response that they had learned previously in Part B. Animals with discrimination habits were permitted to learn position habits which were different from the ones they had adopted in Part A. The number of rats fixating the response in progress would then serve as a measure of the frustrating effects of the insolvable problem in Part C.

These data for each of the sub-groups

been subjected to the insolvable problem in Part A, 8 (34.8%) fixated, whereas 31.6% (6 rats out of 19) of the group which had been given the no-problem situation in that part fixated. The difference between the percentages fixating of the A groups and the B groups is only 3.2% which gives a CR of .22. This difference can be expected only 59 times in 100 and is, therefore, not significant.

When the air-motivated animals are compared with those motivated by food, no difference is found. Of the 24 rats in Groups IA and IB, 9 (37.5%) fixated

whereas 5 of the 18 animals in Groups IIA and IIB (27.8%) fixated. This difference of 9.7% has a CR of .68 and would be expected to occur only 75 times in 100.

It will be remembered that in Part B, significantly more air-motivated than food-motivated animals fixated. This was especially true of the animals that had been subjected to the insolvable problem in Part A. These fixations were broken by guidance and guidance has been found (26) to interfere with the production of fixations. The equivalence in the number of fixations for the differently motivated groups found in Part D might be due to a reduction in the number of fixations in the air-motivated groups. Since more of the rats in Groups IA received guidance than the animals in Group IB, it would be better, if this objection is to be avoided, to compare the number of fixations produced in Group IB with those in Group IIB. These two groups were subjected to the insolvable problem in Part C for the first time.

For this comparison two animals in Group IB will not be considered. These two had fixated in Part B and hence had been guided. (It might be noted here that they did not fixate again.) In Part D, four of the remaining ten animals in this group (40.0%) fixated. Two (28.6% of the seven animals in Group IIB) fixated. When the percentages fixating in each group are compared, it is found that the difference (11.4%) has a CR of .45. This has an expectancy of only 67 times in 100. As this air-motivated group is not significantly different from the food-motivated group, the frustration common to both groups must be considered to be the necessary condition for the production of the fixations.

### *Responses of the Animals Which Did not Fixate*

Table 10 gives the average number of trials taken by rats in the various sub-groups before they abandoned their habits in Part D. These data show that the sub-groups are all approximately the same, especially as the ranges are great and overlap almost completely. The air-motivated animals seem to abandon their discrimination habits more quickly than do the food-motivated animals. However, this difference has a *t*-value of only 1.40 which is between the 10 and 20% level of significance. The two rats with position habits which learned a discrimination response in this part of the experiment took longer to do so than rats which shifted in the other direction. One rat needed 110 trials in which to abandon its position response, the other animal required 186 trials to do so.

Table 10 also shows the average number of trials which occurred after the animal had abandoned its habit in Part D but before it reached the criterion of learning. Again there are no consistent differences between any of the sub-groups or major groups. The ranges overlap to a considerable degree.

The fact that neither of the above measures can distinguish between the differently motivated groups indicates again that there is no basis on which to postulate a difference between the two groups.

### *Refusals to Respond of the Food-Motivated Animals*

None of the 18 animals in Groups IIA and IIB starved to death in Part D. There were, however, eight animals which refused to respond at various times. Three were from Group IIA and five from Group IIB. Of these eight rats,

four fixated and four learned the new response.

The four fixated animals began to refuse to jump after 50.3 trials on the average (range, 40-58 trials). Since all of the refusals were associated with the negative stimulus, these data constitute evidence to show that the fixated rats were able to discriminate between the positive and negative stimuli. Furthermore, the fixated animals began to discriminate between the relevant aspects of the situation at about the same time as the non-fixated rats. The latter abandoned their responses in Part D after an average of 57.7 trials (range, 9-187). However, the fixation prevented the former animals from performing the solution of the problem, and instead, compelled them to jump to the negative card. The four rats made a total of 14 refusals; each lasted from one to seven days. These food-motivated animals thus provide further dramatic substantiation of the completely *abnormal* nature of the fixation.

Three non-fixated animals refused to jump on a total of 10 occasions for periods lasting from one to eight days. All refusals were associated with the negative card. The complete performance of the new response acquired in Part D followed in all cases an interval of refusal to respond. In one instance this refusal lasted for six days, in another for eight days, and in the third case for one day. Why these three animals adopted the new response after extended periods of starvation and the four above animals after an equally long period did not, can not be explained on the basis of the available data.

The behavior of two of the food-motivated animals is of considerable interest. One of these is included in the three above-mentioned rats that did not

fixate. The other has not yet been discussed. Both of these animals solved the problem in Part D. However, both began to jump abortively to the windows they had avoided before adopting the new response. One of these rats began to refuse to jump at the window which it had recently learned to be correct, despite the fact that the rat succeeded in every jump. After nine refusals, this rat reverted to the habit with which it had started Part D. The animal soon began to jump more quickly to both the positive and negative stimuli although it jumped abortively to the negative side. The second animal missed the window when jumping abortively and after a short period, it reverted to the habit it had at the beginning of Part D. This rat then began to refuse to jump to the side which it had learned to avoid a few trials earlier, and experimentation was discontinued. In neither of these cases was the refusal to respond or the abortive jumping necessitated by the objective situation. Both rats successfully solved the problem yet both reverted to the earlier habit. It would seem then that in some instances past experience is a stronger determiner of behavior than the objective situation.

#### ADDITIONAL FINDINGS

##### *The Effect of Guidance Upon Subsequent Tendencies Toward Fixation*

Maier and Klee (26) observed that rats whose fixation had been broken by guidance were less prone to fixate than were rats that had not previously fixated. The present experiment provides another opportunity to check this finding.

At the end of Part B, 14 rats had to be taught the discrimination response by guidance whereas 28 animals learned

the new response by trial and error. The number of fixations obtained from the subsequent frustrating insolvable problem (Part C) can then be compared for guided and non-guided animals. Four or 28.6% of the guided animals fixated whereas 10 or 35.7% of the non-guided rats fixated. The CR of the difference (7.1%) is found to be .47. The expectation (68 times in 100) is not a significant one. These results indicate that guidance *per se* does not markedly reduce the rat's tendency to fixate.<sup>9</sup>

However, not all of the rats retained the habits which they had acquired through the aid of guidance. In Part C, four of these guided animals abandoned their discrimination responses for position habits. These four animals were the only guided rats that fixated in the second test. This suggests that an important factor in the production of fixations is the means by which the animal formed the habit with which it responded to the frustrating situation. In order to test this hypothesis, we can compare the number of fixations occurring among the animals which retained habits that had been established with the aid of guidance and among the animals whose habits had been acquired through trial and error. None of the ten animals fixated which retained guided habits whereas 14 of the 32 animals (43.8%) fixated whose habits had been formed by trial and error.<sup>10</sup> The difference (43.8%) in the percentages of each group that fixated has a CR of 4.99 and can be ex-

pected more than 99.9 times in 100. The difference is, therefore, significant.

These results indicate that guidance does have a therapeutic value providing that the animal retains the guided habit in the frustrating situation. Once, however, the guided rat has abandoned this habit, it is just as likely to fixate as the non-guided animal.

### *The Air Blast as an Emotional Stimulus*

As the air-motivated animals did not always require air before responding, the number of times the fixated animals received air can be compared with the number of times the non-fixated rats required the air. If the fixation is the result of an emotional stimulus, it would be expected that the fixated rats were given air on more occasions.

Although this comparison could be made for the early parts of the experiment, because there are not a sufficient number of cases in each sub-group and the sub-groups can not be combined, any results are subject to too great variation. However, Part C allows us to study all of the air motivated animals since they were all subjected to similar conditions. The mean number of times air was applied to the nine rats which were later found to be fixated was 5.34 times out of the ten trials per day. Air was applied to the fifteen non-fixated rats on an average of 6.11 times a day. The difference of .77 trials was found to have a t-value of only .578 which is at the 50 to 60% level of significance. Thus, there was no demonstrable difference between the fixated and non-fixated animals. It must be concluded, therefore, that an increase in the frequency of emotional stimuli (air applications) is not a factor in the production of fixations.

<sup>9</sup> Of the four rats that were retrained in Part A, none fixated on the first test, but two fixated on the second test. Guidance had only a temporary effect on these animals.

<sup>10</sup> Of these 32 rats, 8 adopted new habits in Part C (four were guided and four were non-guided) and 24 retained habits which had been formed by trial and error in Part B. Five of the eight fixated and nine of the twenty-four fixated. The difference between these two groups is not significant.

### *Relation of Variability to Fixation*

It was discovered in Part A that several animals varied their behavior before they settled down to a consistent mode of behavior. One possibility that must be examined in connection with this pre-habit behavior is that the length of time the animal takes before developing a consistent response might give some indication as to whether or not the animal has been frustrated. It might be supposed that an animal which is frustrated by the insolvable problem will give up its attempts to solve the problem before a non-frustrated animal. For this purpose fixated and non-fixated rats will be compared as to the mean number of trials occurring before the adoption of *habit A*. Only the animals in Groups IA and IIA will be used since they were the only ones that were subjected to the insolvable problem at that time.

The average number of pre-habit responses is 56.4 (range, 0-370) for the fixated animals and 81.4 (range, 0-390) for the non-fixated rats. The difference of 25.0 trials between the means gives a *t*-value of .493, which for 18 degrees of freedom, is significant only at the 60 to 70% level. Thus, the hypothesis of a difference between the fixated and non-fixated rats in this respect must be discounted. The number of trials occurring before the animal adopts a consistent habit is not a measure of frustration. The only test of frustration that has yet been found is whether or not the rat can adapt itself to the new conditions. Under the conditions of the present experiment the result of the frustration is expressed in terms of the abnormal fixation.

### *The Relation of Habit Type to Fixation*

Maier and Klee (26) found when one

group of animals with position habits and another group with discrimination habits were subjected to an insolvable problem that the rats with position habits were more likely to fixate. The results of the present experiment tend to confirm these findings. Of the 20 rats in Groups IA and IIA which formed position habits in Part A, 11 (55.0%) fixated whereas not one of the four rats with discrimination habits did so. Of the 7 animals which adopted position habits in Part C, 5 (71.4%) fixated whereas only 9 of the 35 rats (25.7%) with discrimination habits in this part fixated. The difference in the percentages fixating (45.7%) has a CR of 2.46. The almost significant expectation of 99.3 in 100 again shows the greater susceptibility of the more primitive position habit to fixation.

However, that the primitive nature of the response is not a necessary condition for the formation of fixations is obvious from the fact that other types of responses are also fixated. Not only are the more differentiated discrimination habits fixated but also such complicated mannerisms as the abortive jump. In Part B two fixations of abortive jumps were obtained. In Part D six additional cases were found, one from IA, two from IIA, and three from IIB. In all six instances the rats were given an added 200 trials following their solution of the problem, but none of them abandoned this method of jumping. Some of these jumps required remarkable precision of aim, force of jump, and posture of the body when hitting the foreward wall of the jumping apparatus. A difference of a millimeter in distance or direction often meant the difference between the success and failure of the jump. Yet, many of these rats were consistently successful in this type of response. Therefore, this

form of behavior, at least from the point of view of the skill involved, can not be considered primitive. Perhaps in these cases, dedifferentiation has occurred in areas of behavior other than that of the overt response itself. Whether this is the

case or whether there need be any sort of primitivation at all in the production of the abnormal fixation can only be answered by a further experimental analysis of the problem.

## DISCUSSION

### THE RELATION OF DIFFERENT FORMS OF MOTIVATION TO THE PRODUCTION OF THE ABNORMAL FIXATION

THE RESULTS of the present experiment seem to indicate unequivocally that frustration is the primary factor in the production of the abnormal fixation. Animals which had formed habits under the conditions of the frustrating insoluble problem were on the whole unable to abandon them when another more successful habit was made available. On the other hand, the rats which had developed habits in a situation where they were rewarded 100 percent of the time for a response to any of the relevant stimuli readily abandoned these responses for new ones when required to do so. Furthermore, as both food-motivated and air-motivated animals fixated, it can be considered that an emotion-arousing stimulus was not necessary in the production of the fixation. Just how frustrating the various situations could be was shown by the number of animals which became unable to respond and ultimately starved to death.

However, the difference between the number of air-motivated and food-motivated animals found to be fixated in the first half of the experiment (Parts A and B) should not be overlooked. Significantly more of the air-motivated animals fixated. This difference is probably due to the fact that many of the food-motivated animals refused to respond, some even to the point of complete starvation. What would have happened if these rats<sup>11</sup> had been driven to respond to the situation by some external pressure such

as was employed with the air-motivated animals is of course conjectural. It is quite likely that many of these food-motivated animals would have fixated. In support of this hypothesis is the fact that about half of the rats which refused to respond in the second half of the experiment (Parts C and D) did ultimately fixate. If the same proportion of the animals which refused to respond had fixated instead in Part B the difference would no longer be a significant one.

The above mentioned difference in the number of fixations between the two motivated groups can also be regarded in a different way. The fixations of position habits can be considered as just one of the possible measures of frustration that could have been employed in the present experiment. After all, the air-motivated rats were usually forced to respond to the windows of the jumping apparatus by the air blast. These animals, therefore, did not have the choice of refusing to respond. Any effect of the frustration would then be primarily manifested in connection with one of the responses concerned with jumping to the windows, an abnormal fixation in the present case.

The food-motivated animals were never driven to jump by external pressure. These animals could then react to the frustration by refusing to jump. In the early parts of the experiment these refusals were found to follow one or more failures to make a successful jump. In Part D the refusals were primarily associated with the negative card. They were thus either the result of or in anticipation of failure. However, refusal to jump within the allotted four hour period for any one trial would deprive

<sup>11</sup> There were ten of these animals. Five starved to death, three were guided before starvation was complete and two were dropped from the experiment.

the animal of food on that day. This deprivation should have increased the animal's motivation to respond on the following day. Yet despite the increase in hunger, many of the food-motivated animals refused to continue even to the point of complete starvation. As this increased hunger drive failed to overcome these refusals in many of the cases, one is forced again to recognize the abnormal effects of the frustration on the animal's behavior.

The food-motivated animals can thus be considered to have had a "choice of neurosis." They could as the result of the frustration fixate a response to one of the relevant stimuli or they could refuse to respond. From this point of view, seven of the twenty-seven food-motivated animals developed abnormal reactions to the frustration in these parts of the experiment. (Two of these fixated position habits and five starved to death.) This is about the same proportion of abnormal reactions as was obtained with the air-motivated animals. Thus, there is little or no difference between the two motivated groups in the number of *frustrated* animals. If this interpretation is correct, we are forced again to the conclusion that the frustrating situation produces the abnormal reaction rather than an emotion-arousing stimulus, the air blast.

More of the food-motivated animals fixated jumping responses in the last half than in the first half of the experiment. Furthermore, although many refused to respond for various lengths of time, only one starved to death. As a result, there was no difference in the proportion of fixations between the air-motivated and the food-motivated groups. In addition, the refusals were more specific in nature. They were now associated almost exclusively with the negative stimulus. This

increase in the number of jumping fixations, the decrease in the number of cases of starvation, and the increased specificity of the refusals when they did occur can only be taken to mean one thing. *The food-motivated animals had become progressively more involved in the jumping situation as the amount of their experience in obtaining food in this situation increased.*

This change in the behavior of the food-motivated animals can not be explained on the basis of an increase or accumulation of frustration over the period of the experiment. If that had been true, one would have expected the same increase to have occurred for the air-motivated animals. This is obviously not the case. There was little or no change in the number of fixations among the air-motivated rats from Part B to Part D.

The air-motivated animals, from the point of view of their degree of involvement in the situation, would not be expected to show an increase in the number of fixations. The air blast from the very beginning of the experiment helped to determine the structure of the situation for these animals. The air restricted the behavioral field so that these animals can hardly be considered to have had the choice of not responding. The air-motivated animals were, therefore, involved in the one kind of situation from the very start.

The food-motivated animals never had such a restriction. The strength of the association between the food and the jumping response formed during the preliminary training period probably determined whether or not the rat would respond. From the fact that there were a large number of instances of refusal to respond during the early sections of the experiment it can be considered that

this association had not been very firmly established at that time. Most of the animals reacted to their failure to cope with the situation by refusing to jump. However, as the experience of the rats with the situation increased, they became more strongly dominated by this association. When again confronted with the frustrating situation, those animals which reacted abnormally did so in terms of a fixation of a response directly concerned with the jumping situation. Even when refusals did occur, the animal was reacting to the negative stimulus and not as before, refusing to respond to the entire situation. However, in the last part, the fixation in all cases ultimately compelled the animal to jump to the negative stimulus even though the rat might have refused to jump to it for periods of several days.

If this interpretation is valid, it would constitute a further substantiation of the concept of the degree of involvement. The degree of involvement must then be considered as an important factor in determining the structure of the situation and the type of abnormal reactions produced by the frustration that might be present in it.

To say that frustration is the cause of the abnormal fixation is not to deny that the frustration itself might produce a great amount of emotional tension in the animal. However, the results of the present experiment indicate that it is the animal's failure to adjust to the situation and not the emotional tension that produces the abnormal behavior. As was suggested in the Introduction, the emotional tension will probably serve only to increase the animal's motivation. This resultant motivation will temporarily reduce the animal's behavioral variability. But this temporary reduction of variability that the strong motivation is likely

to produce must be distinguished from the permanent abnormal fixation. The emotional tension that would result from a frustrating situation is related to the production of abnormal behavior only in so far as its resultant strong motivation would further increase the animal's involvement in the situation. One might then expect in any frustrating situation a vicious cycle to be set up which will perpetuate itself in ever increasing intensity until relieved by some form of adjustment, normal or abnormal.

#### *The "Perfect" Nature of the Abnormal Fixation*

One aspect of the abnormal fixation that must be emphasized is the animal's rigid adherence to the fixation once it has been formed. Only in two of the twenty-seven cases of fixation was there a deviation at any time. Even so, each deviation was for one trial only. This amounts to less than .04% of the time. Both deviations were associated with "neurotic seizures" which caused the animal to run about wildly on the jumping platform and later to fling itself at the "wrong" window. Because of the attack, it was impossible to judge whether or not these jumps were made after an actual choice by the animal. The fact that the rat jumped through the window at all may have been purely accidental. If so, the completely unvarying nature of the abnormal fixation is further evidence for the strongly compulsive character of this kind of behavior.

#### *Toward a Definition of Abnormal Behavior*

Mowrer has said: "... one of the distinctive contributions of psychoanalysis has been to break down the dichotomy between 'normal' and 'abnormal,' 'adaptive' and 'maladaptive.' According to psychoanalysis, all behavior . . . is adap-

tive in the basic sense that the individual who is doing the behaving is trying to diminish his discomfort and tensions, thereby obeying the all-inclusive 'pleasure-principle' " (34, p. 75). In the formation of the symptoms which characterize the particular form of abnormal behavior the above statement may very well be true. However, now that most of the witches and demons have been exorcised from psychology, it undoubtedly would be more fruitful to recognize the qualitative difference between the two forms of behavior, the normal and the abnormal. We may even, with some assurance of safety, leave off the quotation marks.

The main objection to the concept of abnormal behavior seems to stem from the fact that the symptoms of such behavior are usually formed just as any other new response is formed. These symptoms are reactions to the selective conditions, the reward and punishment values of the situation. The only possible exception to this would be the cases of primitivation. In the present experiment the position habits formed by the animals in the insolvable situation are just as adaptive or normal as any other response to that situation. But this is true for *that situation only*. No evidence has yet been found that would suggest that animals, which later have been found to have fixated their responses, behaved in the prehabit period differently than animals which did not fixate. Both types of animals "obey" the "pleasure-principle." The law of effect describes all such habit formation. The concept of abnormal behavior thus far delimited would apply only to those forms of behavior which persist after the selective values of the situation have changed. If the animal which has formed an habit under the conditions of 50 percent reward and

punishment is now required to abandon this habit for one it is capable of learning, but does not do so, one must certainly grant that that animal is no longer the same kind of organism. Nor is such an animal comparable to another that can and does learn the new response. The difference lies in the fact that the fixated animal is under a compulsion to continue in the habit first established in the frustrating situation and is not free, therefore, to respond to any alteration in the selective values of the situation.

In most of the regression studies described above, the distinction between an abnormal fixation of the response and a persistence in a response was not apparent. Usually the experiment was not continued past the point of the demonstration of regression. Therefore, no test was made which would discover what an animal which had regressed was able to do in a new situation. In the present experiment and in the investigations of Kleemeier (13), Maier, Glaser, and Klee (24), and Maier and Klee (26), such tests were made. These investigators all demonstrated that the recognition of a distinction between normal and abnormal behavior became necessary if the results were to be explained without throwing out many of the hard won learning concepts. For example, animals which had formed habits under conditions of 50 percent reward and punishment were often unable to abandon them for habits that would have rewarded them 100 percent of the time. On the other hand, animals which had formed habits under the conditions of 100 percent reward, quickly abandoned them for another response when such a change was required. Yet, according to traditional learning concepts, the more frequently rewarded habit should have been the hardest to change.

That these fixations are not due to an incapacity to learn the new response has been repeatedly demonstrated. Following guidance, such fixated animals readily adopt the proper habit. Furthermore, most of the fixated animals, within the limits of their fixation, show that they are attending to and distinguishing between the selective values of the changed situation. The refusals to respond to the negative card in the last part of the present experiment bear witness to this. The fixated animals are unable to perform this change only because they are compelled to remain within the area of the fixated response.

So far our concept of the abnormal has been confined to the compulsive behavior as produced in the fixation and the regression studies. However, because of the compulsive and tenacious nature of most forms of pathological behavior that is psychological in origin, this concept may become more generally applicable. With this in mind, I would like to offer the following working definition of abnormal behavior. Such a definition may enable us to regard and handle in a more fruitful way this kind of behavior as something qualitatively different than

the normal. Furthermore, it will avoid the difficulties encountered in trying to establish norms by statistical methods.

*Behavior Is Abnormal When It Persists Indefinitely in a Situation Where It Is no Longer Relevant*

The criterion of relevance can be determined by what animals which have not been subjected to the conditions which produced the abnormal behavior will do in a similar test situation. Either the animal's previous record itself or another group of animals could serve as a control. In the present experiment the animals which established habits in the no-problem situation served to determine the criterion of normality for the animals which had been subjected to the insolvable problem situation. In a few cases, the animal also served as its own control. For instance, some of the animals which had learned the discrimination in Part B were unable following the insolvable problem to relearn it in Part D. Thus the fixated animals can be considered to have behaved abnormally because they did not respond to properties of the situation to which it had been demonstrated they could respond.

## SUMMARY

THE PURPOSE of the present investigation was to determine whether abnormal fixations were produced primarily as the result of frustration (failure to solve a problem which the rat was motivated to solve) or as the result of an emotional shock such as would be produced by a blast of air. Secondly, if frustration was found to be the cause of the abnormal fixation, the question as to the roles two forms of motivation would play in the production of these fixations was studied.

Two main groups of animals were used. One group was driven to respond by a blast of compressed air. The other group was motivated by food. A modified form of the Lashley jumping apparatus was used.

1. In the first part of the experiment one half of each major group was subjected to an insolvable problem. The problem was insolvable in that no type of habit would be successful more than 50 percent of the time. The second halves of these groups were given a no-problem situation. For these latter groups any response to the stimulus cards would be successful 100 percent of the time. There seemed to be little difference in the overt behavior of the four sub-groups under these conditions as to the type of habit formed and the time it took to form them. Altogether 43 animals formed position habits to one of the sides and 4 formed discrimination responses to one of the stimulus cards. However, 11 of the food-motivated animals refused to respond to the frustrating situation and two of these carried this refusal to the point of complete starvation.

2. All rats in the second part of the experiment were required to abandon

these habits for new ones. Animals with position habits were required to learn discrimination habits; rats with discrimination habits were given position habits to learn. It was found that of the 24 rats which had been subjected to the insolvable problem, 11 failed to change from their first habit, whereas only 2 of the 23 animals which had been subjected to the no-problem situation failed to do so. The animals which were unable to abandon their responses were considered to have fixated them. Since significantly more of the rats fixated which had been subjected to the insolvable problem, the frustration entailed in that situation was concluded to be the cause of the fixation. That the emotional effects of the air blast was not necessary for the production of the fixation was shown by the fact that food-motivated animals fixated.

The two cases of fixation among the animals which had first been given the no-problem situation were believed to be due to the frustration involved in the introduction of a new problem at the beginning of this part of the experiment. This interpretation was substantiated by the fact that three food-motivated rats began to refuse to respond and carried this refusal to the point of complete starvation shortly after they had experienced the change in the situation.

3. Following this, all fixated animals were taught the new habit by guidance. In the majority of the cases, guidance was found to break the fixation successfully. In only one case was the guidance ineffective. All rats were then given additional practice in the second habit. The next part of the experiment subjected all of the animals in each of the two differently motivated groups to an

insolvable problem. Most of the rats (34 out of 43) remained in their second habit under these conditions. Of the remaining nine, one starved to death, and eight formed new habits.

4. In the last period of the experiment all animals were given a new problem to solve. About an equal number of animals in each of the two motivated groups were found to be fixated. Of the 24 air-motivated rats, 9 fixated, whereas 5 of the remaining food-motivated animals did so. None of the rats starved to death. The frustration produced by the insolvable problem to which both groups had been subjected must again be considered as the underlying cause of the abnormal fixation. The conditions which distinguished the sub-groups during the first part of the experiment (the insolvable and no-problem situations) no longer influenced the results.

5. During the first half of the experiment significantly more air-motivated rats than food-motivated rats were found to have fixated. Of the 24 air-motivated rats, 11 fixated, whereas only 2 of the 23 food-motivated animals did so. However, five food-motivated rats starved to death as they refused to leave the jumping platform on any one trial within the four hour period allotted to them in which to jump. As these animals failed to respond in terms of the jumping response to the hunger which thus increased from day to day, they can also be considered to have behaved abnormally. If we count these refusals to respond as a measure of frustration in addition to the abnormal fixation, there would be no difference in the number of frustrated animals in each of the motivated groups at that phase of the experiment. Furthermore, the fact that animals will starve to death in a situation where

a former response has resulted in frequent failure indicates the strongly frustrating nature of that situation.

6. Permanent refusals to respond disappeared during the last parts of the experiment. The food-motivated rats fixated their jumping habits instead. From these facts it was concluded that the original difference in the number of fixations between the two differently motivated groups was due not so much to the emotional character of the air blast but to the way the two forms of motivation influenced the structure of the behavioral field and the degree of involvement of the animal in the situation. The air served to force a response and also to prevent the animal from refusing to respond to the windows of the jumping apparatus. Hence, when these animals were frustrated, the jumping habits were fixated. The food-motivated animals were not forced by an external stimulus to respond to the frustrating situation. Thus, these animals could and often did completely refuse to respond in terms of the jumping habits previously acquired in the situation. After further experience with obtaining food in the situation the remaining food-motivated animals never completely refused to respond to the insolvable problem when it was again introduced, and hence, like the air-motivated rats, reacted abnormally to the frustration in terms of their jumping responses. Since this change occurred only for the food-motivated animals, the increased number of jumping fixations were considered to be due to these animals' progressive involvement in the situation rather than to an accumulation of frustration. The concept of the *degree of involvement* of the animal in the situation was postulated to account for these data.

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